

Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) EP 1 033 881 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:  
06.09.2000 Bulletin 2000/36

(51) Int Cl.7: H04N 7/18

(21) Application number: 00660033.2

(22) Date of filing: 25.02.2000

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE  
Designated Extension States:  
AL LT LV MK RO SI

(72) Inventors:  
• Valkonen, Mika  
44100 Äänekoski (FI)  
• Tolonen, Juha  
40200 Jyväskylä (FI)  
• Snellman, Jorma  
40900 Säynätsalo (FI)

(30) Priority: 01.03.1999 FI 990428

(71) Applicant: Hildco OY Ltd.  
40100 Jyväskylä (FI)

(74) Representative: LEITZINGER OY  
Ruoholahdenkatu 8  
00180 Helsinki (FI)

(54) Method for synchronising image data obtained from process monitoring cameras

(57) The object of the invention is a method for synchronising image data obtained from process monitoring cameras. By utilising synchronisation, one and the same area in a paper web can be sought as it passed the different camera positions. Since the speeds are high and the webs somewhat stretching, synchronisation does not often directly result in the same area being

shown in the different camera positions. To facilitate searching, a selection area (10) corresponding to the limited number of sequential images in the environment of the point of synchronisation (9, 9') of each camera position is visualised for the operator, inside which area the corresponding area in the web can be found with certainty.

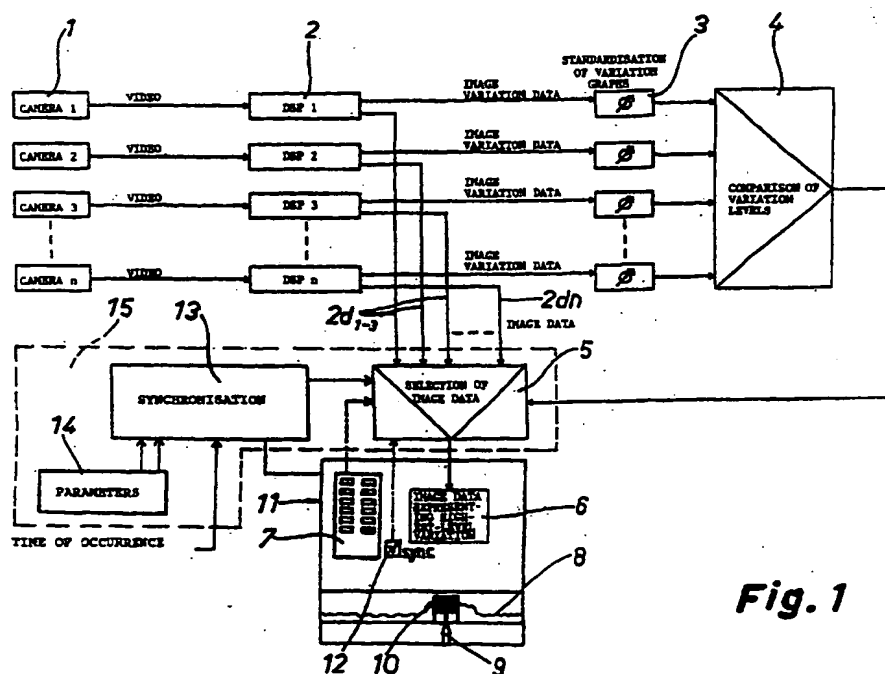


Fig. 1

EP 1 033 881 A2

**Description**

**[0001]** The object of the invention is a method for synchronising image data obtained from process monitoring cameras, in which method

- different positions in the process are imaged using various cameras;
- image data from the different camera positions is stored per camera into digital image processors;
- images stored at the different camera positions are selected for display and analysis on the operator's computer screen; and
- from the image data obtained at the different camera positions are searched images depicting the same area in the web by using synchronisation means.

When the operator finds an interesting object among the images of a particular camera position, by utilising synchronisation he will be able to see the same area in the paper web when it passed other camera positions. This type of synchronisation has long been a characteristic of the Applicant's operations. However, its use involves certain problems or deficiencies. Due to the high speed and stretching of the web, it is not possible for the synchronisation to be so accurate as to necessarily show the corresponding area in the new position which the synchronisation produces. If there is, for example, an interruption at the dry end of the machine and the operator of the monitoring system searches for the same area in the web at the wet end of the machine, the operator cannot be absolutely certain whether the object is located in that area of the video recording displayed as a result of synchronisation, in which case the operator is likely to discontinue the search.

**[0002]** The aim of the present invention is to provide an improved synchronisation method, so that the operator will know for certain that he will arrive automatically in the middle of the visualised area, inside which the desired same area of the web can be found. The idea is, therefore, to compel the operator to go through an area of sequential images of a size that can be parametrised. In such a case, the corresponding area in the web in different camera positions will be found more reliably and easily.

**[0003]** The characteristic features of the method relating to the invention are presented in the appended claims 1 and 2. The dependent claims disclose preferred embodiments of the invention.

**[0004]** An exemplary embodiment of the invention is described in the following with reference to the accompanying drawings in which

Figure 1 shows the system used for implementing the synchronisation method relating to the invention as a flow chart, and

Figure 2 illustrates the performance of synchronisation on the basis of image data from different camera positions.

5 **[0005]** The general structure and operation of the system are first described before disclosing the manner according to the invention for visualising the area of sequential images to be synchronised to the operator.

10 **[0006]** In the flow chart shown in Figure 1, the image source is a video camera 1 which produces a continuous video image of the object being monitored. The image data is processed in a digital signal processor 2, or DSP processor. Signal processors are similar to ordinary microprocessors, but contain, among others, the use of floating-point number technology and address formats for easier addressing. Furthermore, the DSP is markedly different from the ordinary processor in terms of its architecture, having been designed for duties involving large amounts of data, and where multiplication with integers and data transfers are statistically significant operations. DSP processors are capable of performing a plurality of different and simultaneous calculation routines associated with image analysis, the results of which can be applied automatically to monitoring changes in image data.

25 **[0007]** The system comprises several video cameras 1 for imaging the various positions of the process being monitored. Each camera is provided with its own digital image processor 2 for storing digital image data per camera. The signal processors 2 are used for analysing each camera-specific image data item so as to provide image variation data based on the level of variation in a plurality of sequential images. From the signal processors 2 the said image data and image variation data are transmitted to an analysing computer 15 which has a display 11.

30 **[0008]** The images stored at the different camera positions can be selected for analysis by means of selector icons 7. The image variation graph 8 corresponding to the image variation data of images preceding and following the image to be analysed is displayed at the bottom of the screen 11. A floating arrow designated by reference numeral 9 indicates the point on the image variation graph 8 at which the image 6 displayed is located.

45 The floating arrow 9 can be used for selecting an image at any point on the graph 8 for display. The image data  $2d_1 - 2d_n$  stored from each camera position 1-n may encompass several hundred images. Depending on the process, the image data in store at each time may have a duration ranging from a few seconds to several minutes, and the storage may function on the FIFO (first in first out) principle.

50 **[0009]** Since each image variation graph 8 shown at the bottom of the screen 11 is prepared of image material from each camera position respectively, the image variation graphs of the different camera positions can be standardised so as to be comparable, and be compared with each other, whereby the image variation

graph representing the highest-level variation and the image data of the camera position corresponding to it can be selected automatically for displaying on the analysing window of the screen 11. For the purpose of this automation, the system is provided with standardising means 3 for standardising the output levels of the image variation data of the different camera positions to be mutually comparable. A comparison between the standardised image variation levels of the different camera positions is performed by means of comparator means 4. Selector means 5 receive image data from the different camera positions and select, under the control of the comparator means 4, the image data  $2d_1 - 2d_n$  representing the highest-level variation and the corresponding image variation graph 8 to be displayed on the screen 11. Image 6 is one of a multitude of images included in the image data. The graph 8 and the floating indicator 9 can be used for examining those very images 6 associated with the area of the highest-level image variation. The image 6 on the screen 11 may represent, for example, a hole formed in a paper web.

[0010] The automated selection of the image 6, as described above, is obviously optional, meaning that the operator may, if he so desires, select image data  $2d_1 - 2d_n$  from any camera position for analysis. However, it is often useful for the operator to know at the very beginning of analysis which camera position produced the highest-level image variation, in which case the analysis can be started from this particular camera position.

[0011] The operator's data processing means 15 comprise synchronisation means 12, 13, 14 by means of which images depicting the same area in the web can be sought automatically from the image data of different camera positions. When the synchronisation option 12 is displayed on the screen 11, the synchronisation unit 13 controls the image data selection unit 5 in such a way that the selection of a camera position by means of the selector icons 7 automatically produces on the screen 11 the image 6 which corresponds to the same area in the paper web as the image 6 of the previous camera position. For this purpose the synchronisation unit 13 requires certain parameters 14, which include at least web speed and the distances between the cameras 1. The synchronisation unit 13 is also given a time of occurrence  $2t$  at which an interesting object was observed in the image field of a camera position, the web area corresponding to which having to be analysed from the different camera positions.

[0012] Figure 2 shows a hole, for example in the size press, in an image produced at point of time  $2t$  in the image data  $2d_n$  of camera  $n$ . On the basis of the time of occurrence and other parameter data, the synchronisation unit 13 is able to determine, by means of simple calculations, the images  $2s_1 - 2s_3$  in the image data  $2d_1 - 2d_3$  in which the same hole appears. The accuracy of synchronisation cannot, however, be very high due to the high speed and stretching of the web, and thus in the invention is specified a marker 10, 10' of a certain

width, which is visualised for the operator, within which the corresponding point in the web will be found with certainty. For the operator is thus visualised a selection area 10 in the environment of the point of synchronisation 9, 9' of each camera position, within which area there is a limited number of sequential images among which the corresponding point will be found with certainty. The said limited number is preferably a minimum number determined by the parameters such as web speed and distance between the camera positions. This marker area 10 motivates the operator to search for the corresponding point in the different camera positions. The size of the selection area 10, that is, the number of images contained by it is, therefore, dependent on web speed and the distances between the cameras.

### Claims

1. A method for synchronising image data obtained from process monitoring cameras, in which method

- different positions in the process are imaged using various cameras (1);
- image data ( $2d_1 - 2d_n$ ) from the different camera positions is stored per camera into digital image processors (2);
- images stored at the different camera positions are selected for display and analysis on the operator's computer (15) screen (11); and
- from the image data ( $2d_1 - 2d_n$ ) obtained at the different camera positions are searched ( $2t, 2s_1 - 2s_3$ ) images depicting the same area in the web by using synchronisation means (12, 13, 14),

characterised in that for the operator is visualised a selection area (10) corresponding to the limited number of sequential images in the environment of the point of synchronisation (9, 9') of each camera position.

2. A method for synchronising image data obtained from process monitoring cameras, in which method

- different positions in the process are imaged using various cameras (1);
- image data ( $2d_1 - 2d_n$ ) from the different camera positions is stored per camera into digital image processors (2);
- images stored at the different camera positions are selected for display and analysis on the operator's computer (15) screen (11); and
- from the image data ( $2d_1 - 2d_n$ ) obtained at the different camera positions are searched ( $2t, 2s_1 - 2s_3$ ) images depicting the same area in the web by using synchronisation means (12, 13, 14),

**characterised** in that for the operator is visualised a selection area (10, 10') representing the limited number of sequential images, the image ( $2s_1 - 2s_3$ ) inside the said area being brought to the screen (11) by the synchronisation means when the image on the screen moves from one camera position to another, the size of the selection area (10), that is, the number of images contained by it, being dependent on the speed of the paper web being monitored and the distances between the cameras.

3. A method as claimed in claim 1 or 2, **characterised** in that the process is paper manufacture and the object being monitored is the paper web running in the paper machine.
4. A method as claimed in any of the claims 1 to 3, **characterised** in that camera-specific image data is analysed and image variation data based on the level of variation in a plurality of sequential images is compiled, and the image variation graph (8) corresponding to the image variation data of images preceding and following the image to be analysed is displayed on the screen (11).
5. A method as claimed in any of the claims 1 to 4, **characterised** in that the output levels of the image variation data of the different camera positions are standardised so as to be mutually comparable, the standardised image variation levels of the different camera positions are compared, and the image data ( $2d_1 - 2d_n$ ) of the camera position representing the highest-level variation is selected for automatic display.

BEST AVAILABLE COPY

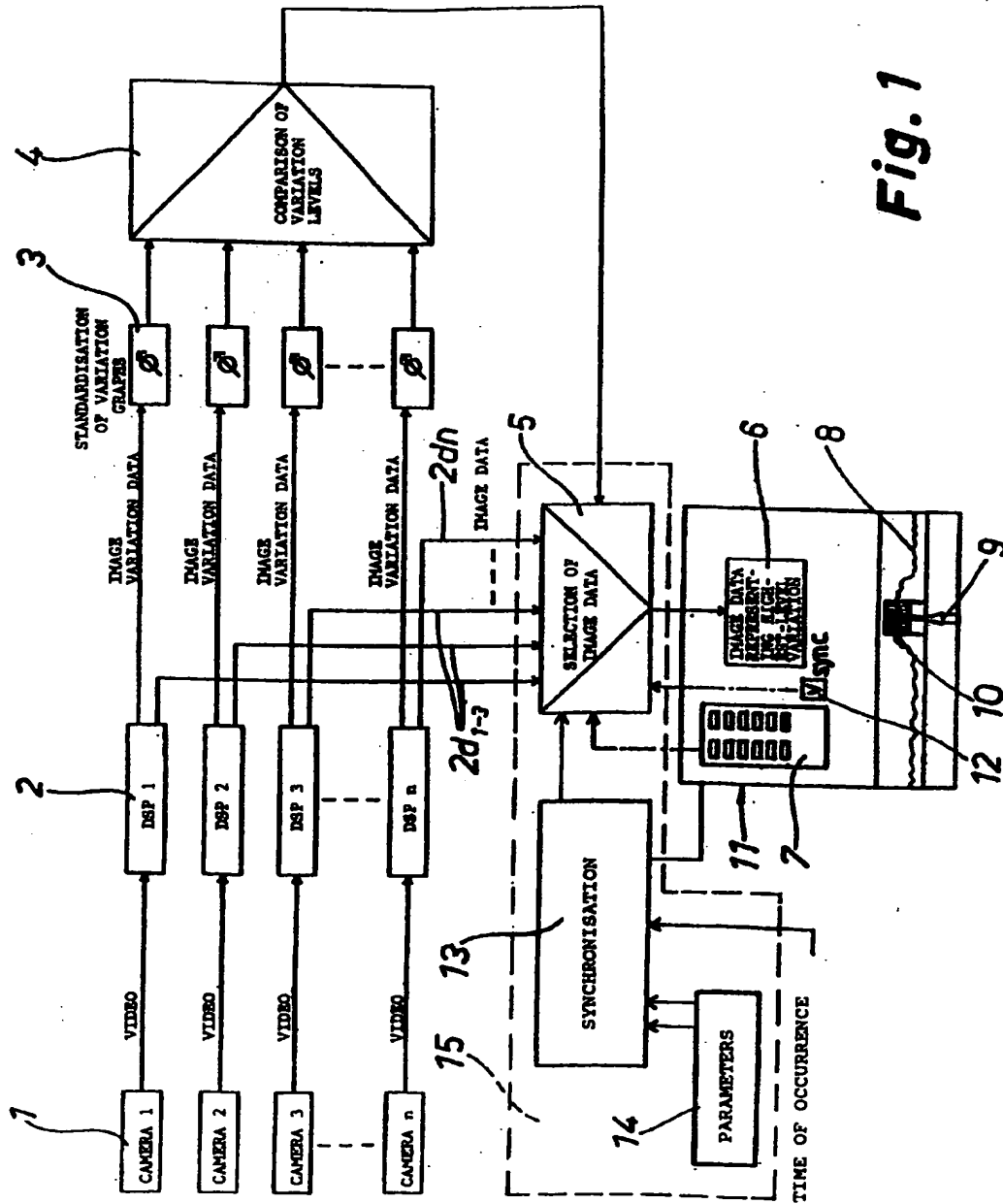


Fig. 1

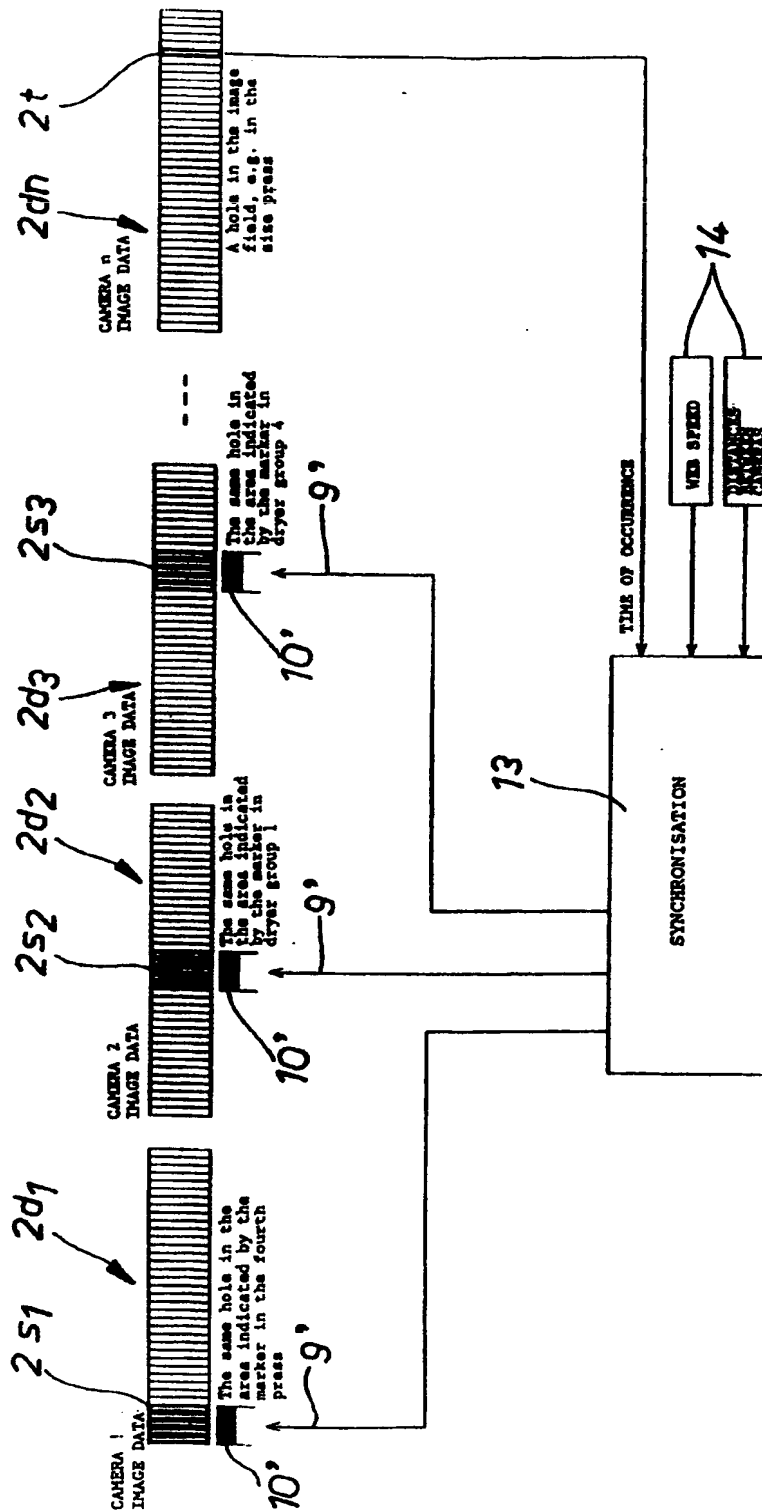
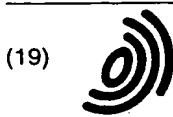


Fig. 2



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) EP 1 033 881 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:  
05.06.2002 Bulletin 2002/23

(51) Int Cl.7: H04N 7/18

(43) Date of publication A2:  
06.09.2000 Bulletin 2000/36

(21) Application number: 00660033.2

(22) Date of filing: 25.02.2000

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE  
Designated Extension States:  
AL LT LV MK RO SI

(72) Inventors:  
• Valkonen, Mika  
44100 Äänekoski (FI)  
• Toivonen, Juha  
40200 Jyväskylä (FI)  
• Snellman, Jorma  
40900 Säynätsalo (FI)

(30) Priority: 01.03.1999 FI 990428

(71) Applicant: Honeywell Oy  
40500 Jyväskylä (FI)

(74) Representative: LEITZINGER OY  
Tammasaarekatu 1  
00180 Helsinki (FI)

(54) Method for synchronising image data obtained from process monitoring cameras

(57) The object of the invention is a method for synchronising image data obtained from process monitoring cameras. By utilising synchronisation, one and the same area in a paper web can be sought as it passed the different camera positions. Since the speeds are high and the webs somewhat stretching, synchronisation does not often directly result in the same area being

shown in the different camera positions. To facilitate searching, a selection area (10) corresponding to the limited number of sequential images in the environment of the point of synchronisation (9, 9') of each camera position is visualised for the operator, inside which area the corresponding area in the web can be found with certainty.

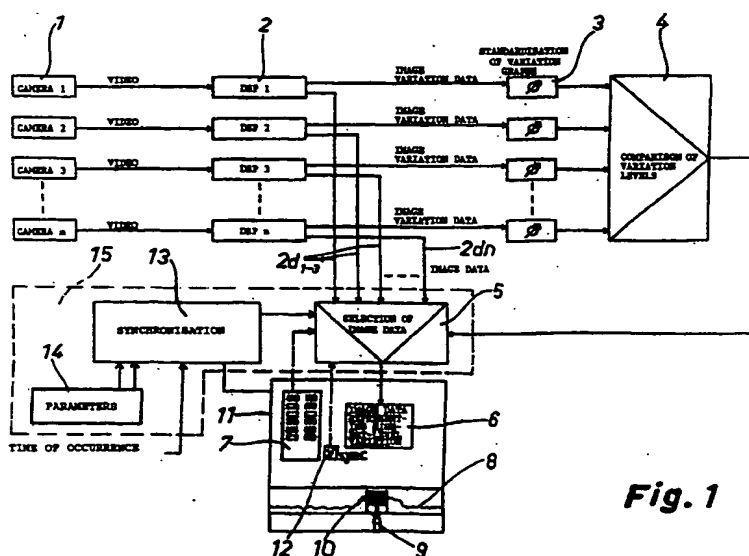


Fig. 1



European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 00 66 0033

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	WALTZ F M: "Fast signal processing hardware for industrial inspection" STATISTICAL SIGNAL AND ARRAY PROCESSING. MINNEAPOLIS, APR. 27 - 30, 1993, PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING (ICASSP), NEW YORK, IEEE, US, vol. 4, 27 April 1993 (1993-04-27), pages 40-43, XP010110290 ISBN: 0-7803-0946-4 * the whole document *	1-5	H04N7/18
A	EP 0 847 201 A (DAVID ANTOINE) 10 June 1998 (1998-06-10) * the whole document *	1-5	
A	US 5 668 887 A (PARKER H GALEN ET AL) 16 September 1997 (1997-09-16) * column 6, line 11 - column 11, line 25 *	1-5	
A	EP 0 366 235 A (PICKER INT INC) 2 May 1990 (1990-05-02) * column 2, line 18 - column 3, line 51 *	1-5	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H04N G01N
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 12 April 2002	Examiner Greve, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 (03.82) (P04C01)



**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 66 0033

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-04-2002

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 0847201	A	10-06-1998	FR	2757002 A1	12-06-1998
			EP	0847201 A1	10-06-1998
US 5668887	A	16-09-1997	EP	0738886 A2	23-10-1996
			JP	8292159 A	05-11-1996
			DE	69330010 D1	19-04-2001
			DE	69330010 T2	13-09-2001
			EP	0572336 A1	01-12-1993
			JP	6043115 A	18-02-1994
			US	5533139 A	02-07-1996
EP 0366235	A	02-05-1990	US	4922337 A	01-05-1990
			DE	68908851 D1	07-10-1993
			DE	68908851 T2	16-12-1993
			DE	68922957 D1	13-07-1995
			DE	68922957 T2	19-10-1995
			EP	0366235 A1	02-05-1990
			EP	0369585 A1	23-05-1990
			JP	2121577 A	09-05-1990
			JP	3091969 B2	25-09-2000
			JP	2141647 A	31-05-1990
			JP	2955715 B2	04-10-1999
			US	RE36047 E	19-01-1999
			US	4949172 A	14-08-1990

**THIS PAGE BLANK (USPTO)**